General objectives

- Joined statistical analysis of surface soil moisture datasets
  - acquired across a variety of land use types
  - on different spatial scales (plot to mesoscale catchment)
  - with different methods (field measurements, remote sensing, and modelling)
- better understand temporal and spatial soil moisture patterns at different scales
- identify driving parameters and processes explaining these patterns and their temporal dynamics

The Rur catchment

Soil moisture data sets:
- Northern part (crops):
  1) ALOS, C-band radar remote sensing (15m)
  2) ENVISAT, C-band radar remote sensing (150m)
  3) Danubia, model (150m)
- Wüstebach sub-catchment (forest):
  4) SoilNet, automated sensor network (5-50m)
  5) HydroGeoSphere, model (5-50m)

Descriptive statistics: Spatial Mean – Coefficient of variation

Autocorrelation

Tobler’s first law of geography: “Everything is related to everything else, but near things are more related than distant things.”

- Cross-correlation of a signal with itself
- Similarity between observations as a function of the space- or time-lag between them

Autocorrelation analysis with semivariograms

Fractals

Log-log plot of the semivariances:

\[ D = 3 - B / 2 \]

with \( B \) as the slope of the regression line in the log-log plot of the variogram


Conclusion

- Three groups of datasets with consistent range parameters (geostatistics) and scale breaks (fractal analysis) were found
  - associated with small scale topography (forest sub-catchment)
  - field sizes (Rur catchment) and
  - large scale variability of soil types (Rur catchment)
- Generally high fractal dimensions, high spatial variability of soil moisture
- Multifractal behavior with at least one scale break, indicating that various processes or driving parameters operate at different scales
- A multi-fractal model is seen as an appropriate approach to capture and describe the nested scales of variability of soil moisture patterns

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